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NOTES UPON ALTERNATION OF THE HEART

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With Plate 22

AMONGST the several affections of its mechanism to which the human heart is subject, none perhaps is less understood than alternation of the strength of its contractions. A great many observations have been made in regard to it, but the explanation of its production is still wrapped in obscurity.

During the course of a systematic investigation of cardiac irregularities, clinical and experimental, I have met with heart alternation in slight and marked degree on many occasions. From a number of observations a few, hitherto undescribed, have been selected for publication.

Heart alternation occurs under two circumstances. It is seen when the cardiac muscle is not of necessity altered structurally, as an accompaniment of great acceleration of the rate of rhythm. It is also found when the pulse is of normal rate, and under such circumstances the muscle is either markedly degenerate or the heart shows evidence of embarrassment as a result of poisoning or some other factor.

The observations now published are drawn from the first group.

Divergent Alternation.

In studying the effect of ligation of the coronary arteries, it was found that an obstruction of one or the other is usually followed by the appearance of rapid and new rhythms arising in the ventricle; and a detailed account of such rhythms will be found in another place (3). Suffice it to say that the ventricular rhythm dominates that of all the cardiac chamber; and that if the heart rate is greatly increased, alternation frequently appears. Examples of the curves obtained under these conditions are shown in Figs. 1 and 2. The four tracings of Figs. 1 and 2 were each obtained in similar manner. The uppermost curve in each is a ventricular myocardiograph, taken with a modification of Roy and Adami's instrument; the points of attachment were transversely across the centre of the heart. The second curve in each is a similar record from the right auricle. The third curve is a carotid pressure tracing, taken with a Hürthle manometer.

In a recent paper Hering has published simultaneous apex and radial curves from the dog and from a clinical case, which appear to demonstrate that, when alternation in excursion in both is manifested, the larger excursion in one

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may be found to correspond to the smaller excursion in the other. The fact that the large apical curve may correspond to the smaller radial beat seems such a remarkable phenomenon, that, regarded as an expression of the relationship of the strength of ventricular contraction and the amplitude of the corresponding arterial curve, it can hardly meet with acceptance in the absence of confirmatory and more direct evidence. This evidence is provided by the three accompanying curves (Fig. 1). The curves represent a paroxysm of regular tachycardia in which the auricle is responding to the ventricle. Attention is drawn to the fact that in these curves the systoles of the ventricle (above) and of the auricle (below) are represented by downstrokes. They illustrate the changed relationship which may be found in ventricular, auricular, and carotid curves within short spaces of time. A few seconds intervene between each strip. In the first curve the large ventricular beat corresponds to the large auricular beat and to the large carotid upstroke. In the second curve the large ventricular beat corresponds to the large auricular and to the small carotid beat. In the third curve the large ventricular beat corresponds to the small auricular beat and to the large carotid beat.

It is shown, therefore, that the excursion of the arterial curve, when alternation is present, is not necessarily associated with parallel alternation in the amplitude of the ventricular muscle excursion, and that in one and other the alternation may be divergent. The simultaneous alternation in the auricle is of special interest. It is clearly shown to be independent of the ventricular alternation by a comparison of the first two with the last curve, for in the first two curves the auricular and ventricular alternations run with parallelism, while in the last they are divergent. Now if the exact relationship of the auricular and ventricular systoles be compared in any one of these curves it will be found that the auricular systole commences a trifle before the beginning of the diastole of the ventricular cycle to which it belongs (and to the contraction of which it is a response), and that it extends well into the said diastole. In brief, the auricular systoles are efficient in that they aid the filling of the ventricle. We have an immediate and I believe helpful clue to the appearance of divergent alternation in ventricle and carotid in the middle curve, for in this tracing, as opposed to the first, the auricular alternation is marked in its degree. The strong carotid pulsation is the result of the weak ventricular contraction, but the efficiency of the latter is reinforced by the preceding strong auricular contraction; similarly the small carotid pulsation is the outcome of the strong ventricular contraction, but the efficiency of the latter is embarrassed by the relatively small influx of blood as a result of the preceding weak auricular contraction. A comparison of the middle and right-hand curves (Fig. 1) will show that the ventricular excursion is of equal extent in each. The auricular and carotid alternations taken together are also divergent in each; but in the one instance the divergent auricular alternation increases the carotid alternation (right-hand curve), while in the other it diminishes it (middle curve).

The explanation offered of the curious anomaly presented by the middle

figure, namely, divergence of ventricular and carotid alternation, is strongly supported by further observation upon the same animal (the whole series of curves was obtained within a space of three minutes, and they are given in the order of their occurrence). At the commencement and ending of this figure (Fig. 2), strips of alternation are shown in which the occurrences are similar to those seen in Fig. 1 (right-hand curve). Over the central portion of the strip the vagus was stimulated; the ventricle is beating in response to inherent impulse formation, and the sole effect of the vagus excitation, in this instance, is the temporary suspension of auricular activity. But at three points an auricular response to ventricle is recorded, and the effects of these three beats are strikingly shown in the carotid curve. The first escaped auricular beat (1) falls *during* a *weak* ventricular contraction (1), and its influence is felt by the succeeding strong carotid pulsation (1), which is markedly exaggerated. The next auricular contraction (2) is a response to a *strong* ventricular systole (2), with which it falls; as a consequence it causes a temporary abolition of alternation in the carotid, by increasing the amplitude of an expected weak carotid beat (marked 2). The third response shows similar time relationships to the first, and gives rise to similar carotid changes; but it may be noted that just as the third auricular beat is weaker than the first, so the third carotid beat is weaker than the first.

As a result of these observations, therefore, it seems clear that certain instances of divergent alternation in ventricle and carotid may be the result of simultaneous alternation in the auricle.² A curve has been published by Volhard which supports this view. He gives simultaneous curves from jugular, apex, and radial in a patient exhibiting alternation. In his figure (Fig. 1) the larger apical curve corresponds to the smaller radial beat, but alternation is also seen in the amplitude of the *a* waves in the jugular, and in this instance the small radial beat is preceded by the small *a* wave.

The Electrocardiogram in Clinical Alternation.

This note upon heart alternation may be concluded by a brief description of some electrocardiographic curves obtained from a patient, the subject of auricular tachycardia, whose case has been otherwise fully described in a previous communication (3). The facts in regard to the electric curves in alternation are already known as a result of experimentation (1 and 2), and their publication is chiefly demanded because it brings the clinical and experimental appearances more closely into line.

Each of the accompanying photographs portrays an electrocardiogram and radial curve from the same patient. All are from paroxysmal periods, and the abnormal (in this case inverted) *P* variation is seen superimposed upon *T*, the second ventricular variation. It notches it in a downward direction, occurring at the commencement of *T* in Fig. 3, I and III, and near the apex of *T* in

² It should be stated that the auricular myocardiogram was obtained from the right auricle, and that it is assumed that alternation was also present in the left.

Fig. 3, II. It will suffice if the chief points demonstrated by the curves are noted. The shape of each ventricular complex shows it to result from a contraction of supraventricular origin. The distinction between alternation and premature ventricular contractions arising late in the cycle is clearly defined. From beat to beat the curves are similar in their general conformation; they fail to support the view expressed by Hering that alternation may result from intraventricular heart-block, for under such circumstances a notable change in the general outline from beat to beat would be expected.

The alternate beats show only slight quantitative changes in the several peaks. The short *R* is usually accompanied by a slightly exaggerated *T* (Fig. 3, I), though it may be accompanied by a diminished *T* (Fig. 3, II), or by a *T* in which no change is detected.

The relationship to alternation in the arterial curve is equally variable and equally obscure. In the beginning of Fig. 3, I, alternation in *R* runs parallel with that of the pulse for the first four beats. That is to say, the tall *R* corresponds to the slightly taller radial beat. In the last beats of the same photograph the trace of alternation in the pulse vanishes, while the alternation of *R* increases somewhat. Alternation of the pulse to extinction is shown in the next figure, and the complex composed of a high *R* and a high *T* is associated with absent radial pulsation. In the last figure alternation is well defined in the radial curve, while it is not discoverable in the electrocardiogram.

The explanation of these phenomena is unknown, and a discussion of them is impossible at the present time.

Conclusions.

1. Divergent alternation of ventricle and carotid, a condition in which the large ventricular contraction corresponds to the small carotid upstroke, is encountered experimentally. The divergence is due in some instances to simultaneous alternation of the auricle.

2. The electrocardiographic curves obtained in clinical heart alternation are similar to those obtained experimentally; there is a divergence between the heights of *R* and *T* and the amplitude of the radial upstrokes. These facts demonstrate the identity of the clinical and experimental conditions.

REFERENCES.

1. Hering, *Münch. med. Wochenschr.*, 1908, lv. 2. 1417; *Zeitschr. f. exper. Pathol. u. Therap.*, Berlin, 1909, vii. 363.
2. Kahn and Starkenstein, *Arch. f. d. ges. Physiol.*, Bonn, 1910, cxxxiii. 579.
3. Lewis, *Heart*, Lond., 1909-10, i. 98 and 262.
4. Volhard, *Münch. med. Wochenschr.*, 1905, lii. 1. 590.

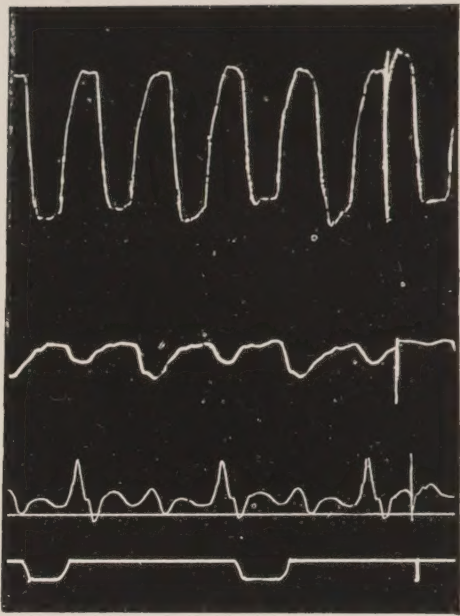
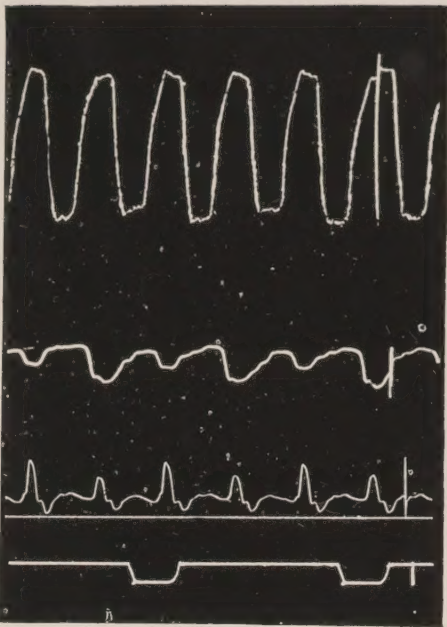
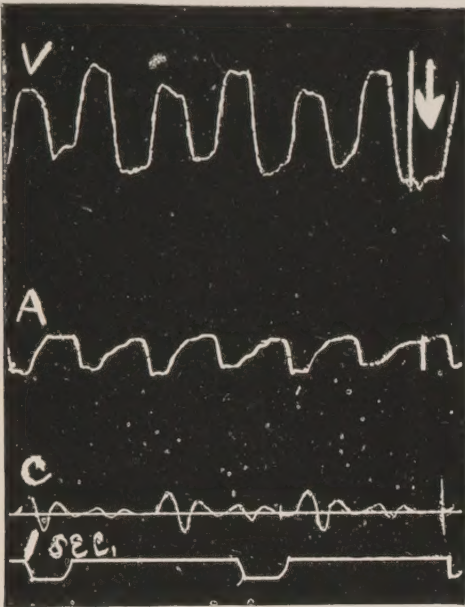


FIG. 1

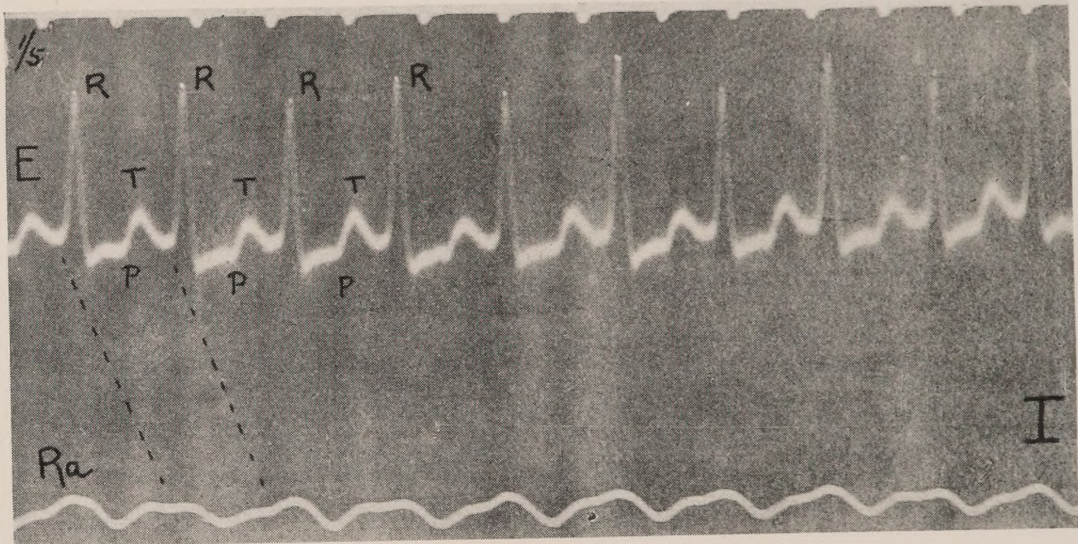
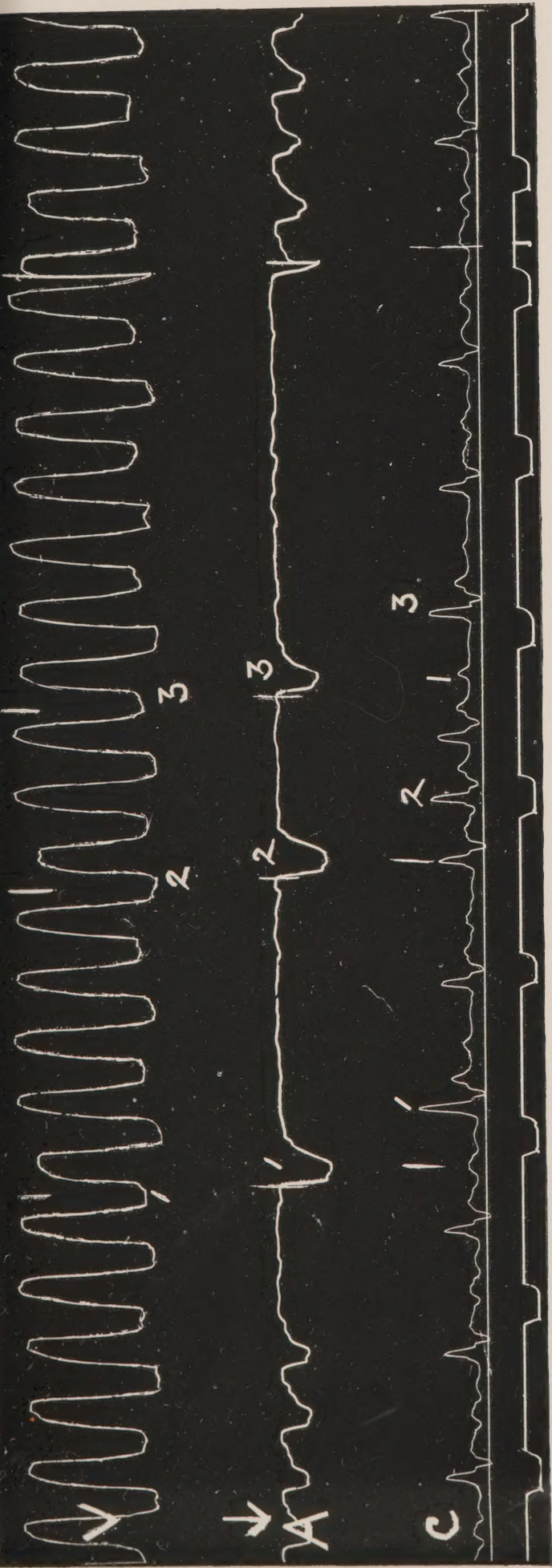


FIG. 2

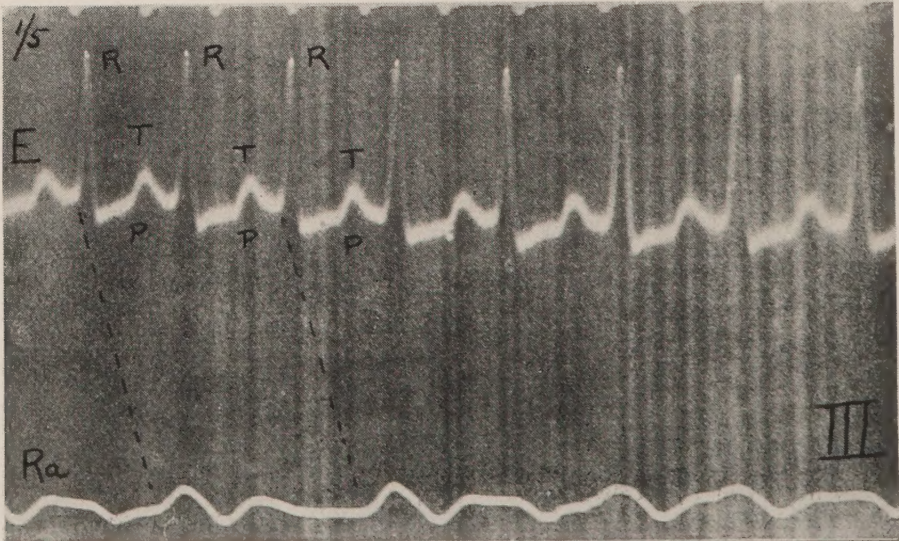
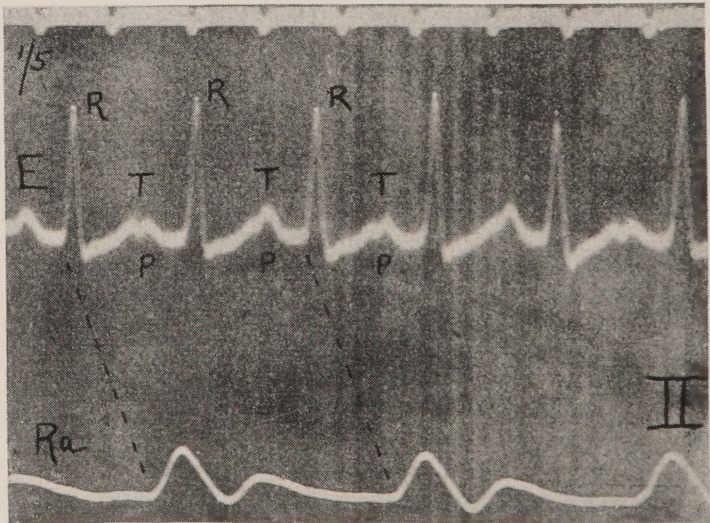


FIG. 3

